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Allen et al.

[11] **4,155,425**

[45] **May 22, 1979**

[54] **STABILIZED HYDRAULIC ELEVATOR**

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[73] Assignee: **A. S. K. Elevator Service, Inc.**, Greensboro, N.C.

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[22] Filed: **Aug. 16, 1977**

[51] **Int. Cl.**[2] **B66B 11/04**

[52] **U.S. Cl.** **187/17**

[58] **Field of Search** 187/17, 24, 25, 32, 187/34, 35, 36

[56] **References Cited**

U.S. PATENT DOCUMENTS

186,455	1/1877	Bragaldi	187/24
438,913	10/1890	Deblieux	187/24
3,399,887	9/1968	Altier	187/17
3,650,356	3/1972	Brown	187/17
4,062,269	12/1977	Chichester et al.	187/17

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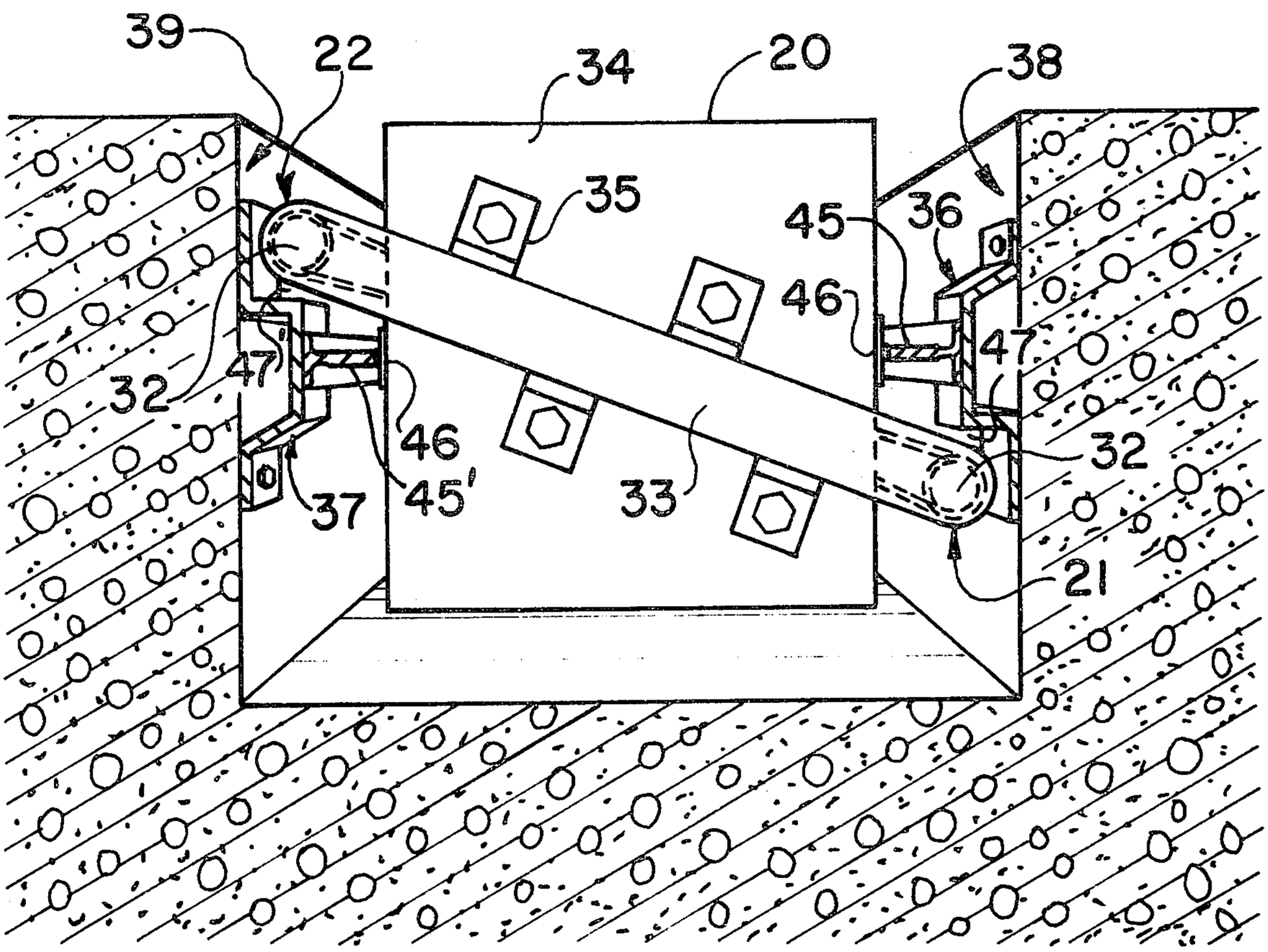
Assistant Examiner—Jeffrey V. Nase
Attorney, Agent, or Firm—Clifton T. Hunt, Jr.

[57] **ABSTRACT**

A hydraulically operable elevator having a vertically reciprocable cab suspended from an overhead structure by differential hydraulic piston systems which are responsive to introduction of hydraulic fluid to decrease the overall length of the differential pistons causing the cab to ascend, and which are responsive to withdrawal of hydraulic fluid from the piston assemblies to increase the overall length of the differential pistons, allowing the cab to descend. Only one differential piston assembly is required on each side of the transverse axis of the cab to increase its stability and to provide maximum cross-sectional area for the interior of the cab.

5 Claims, 7 Drawing Figures



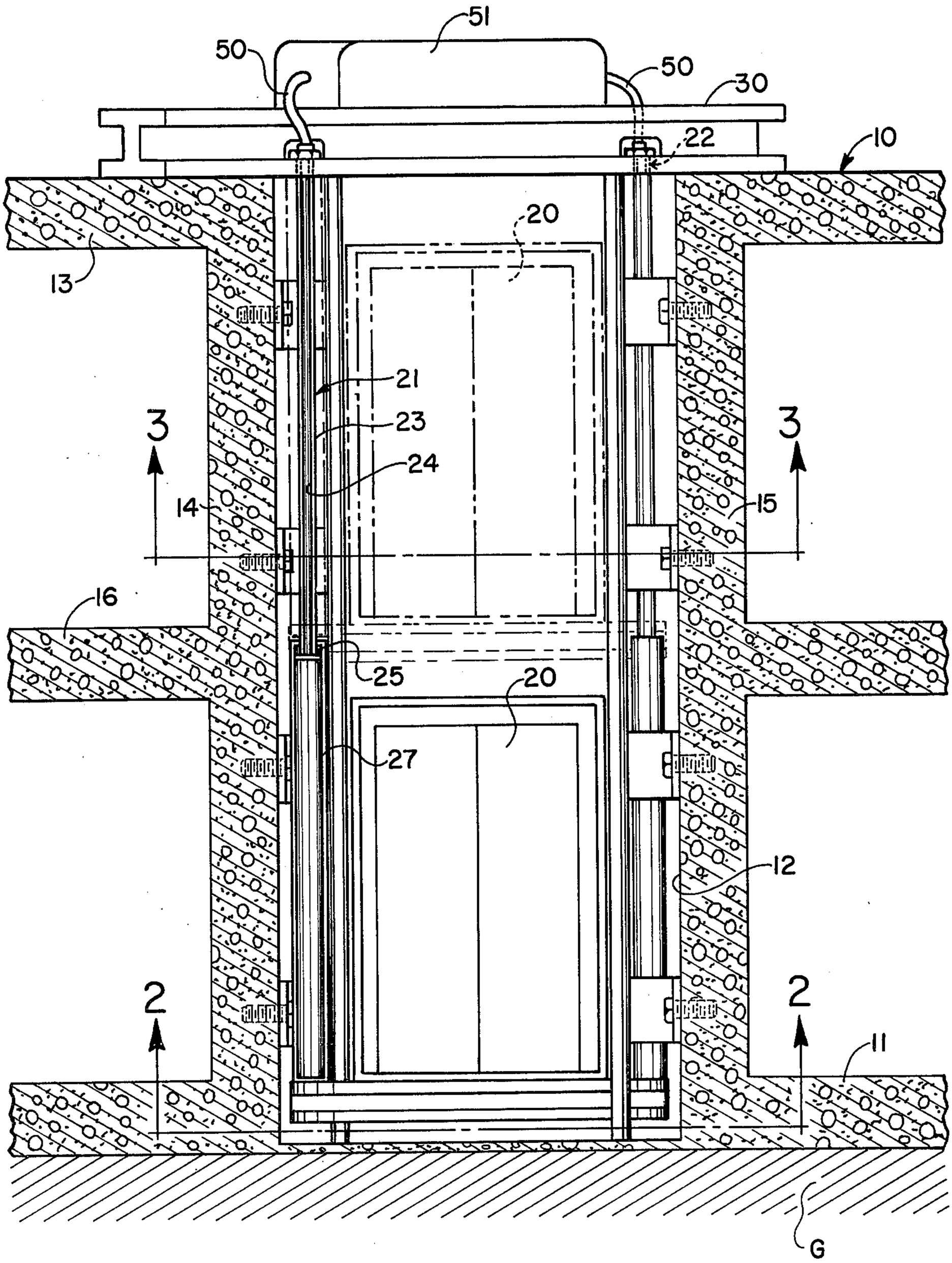


FIG. 1

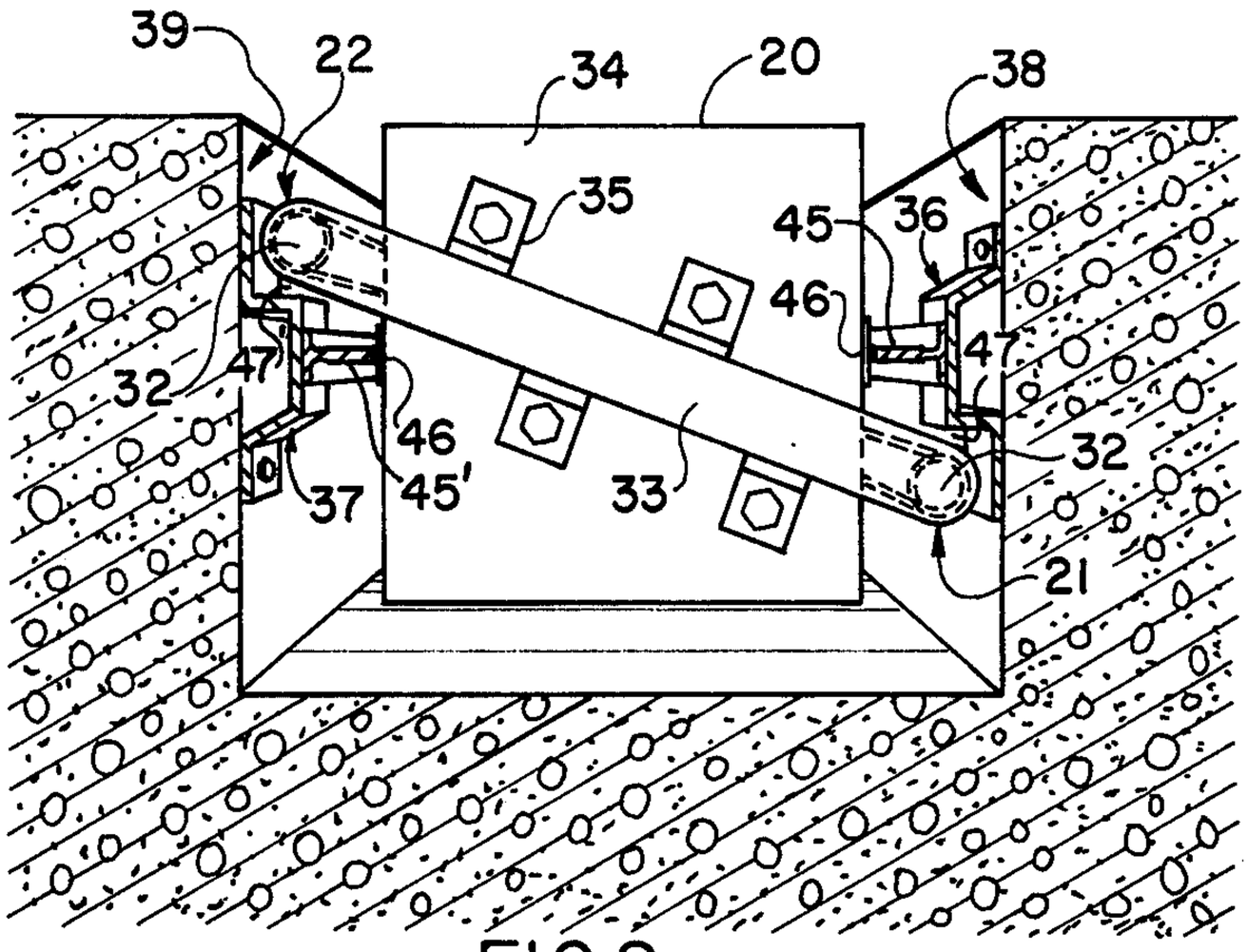


FIG.2

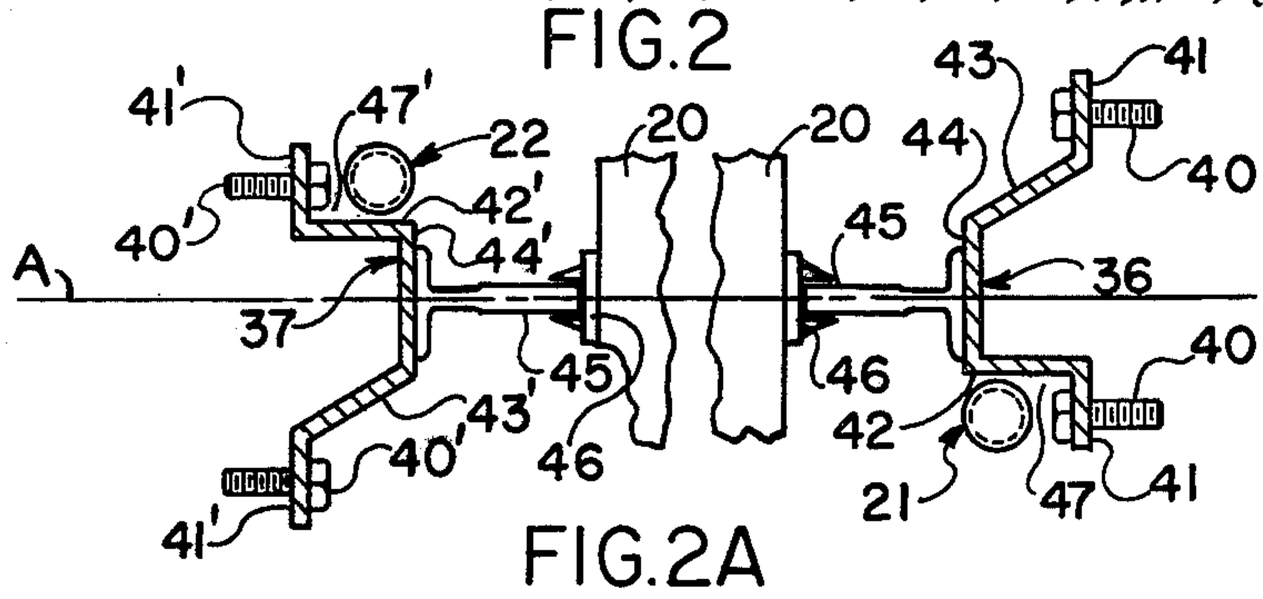


FIG.2A

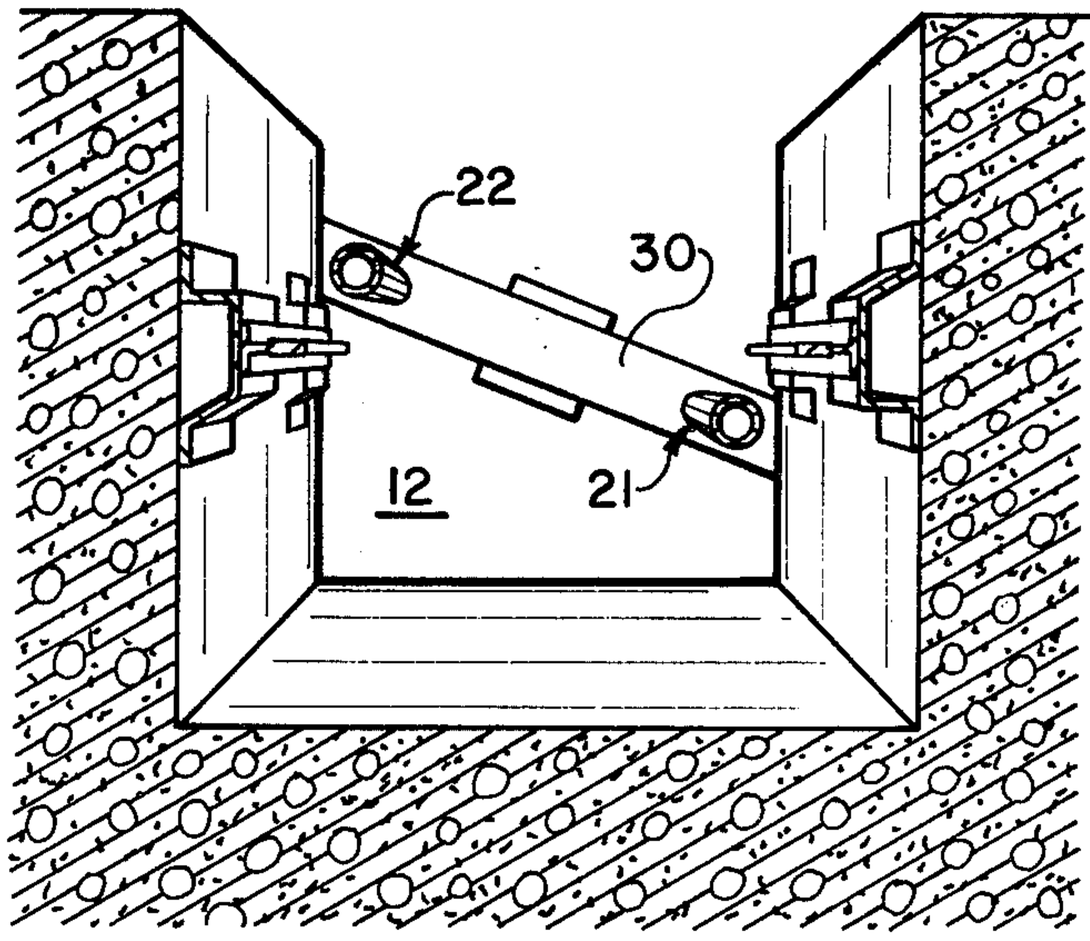


FIG.3

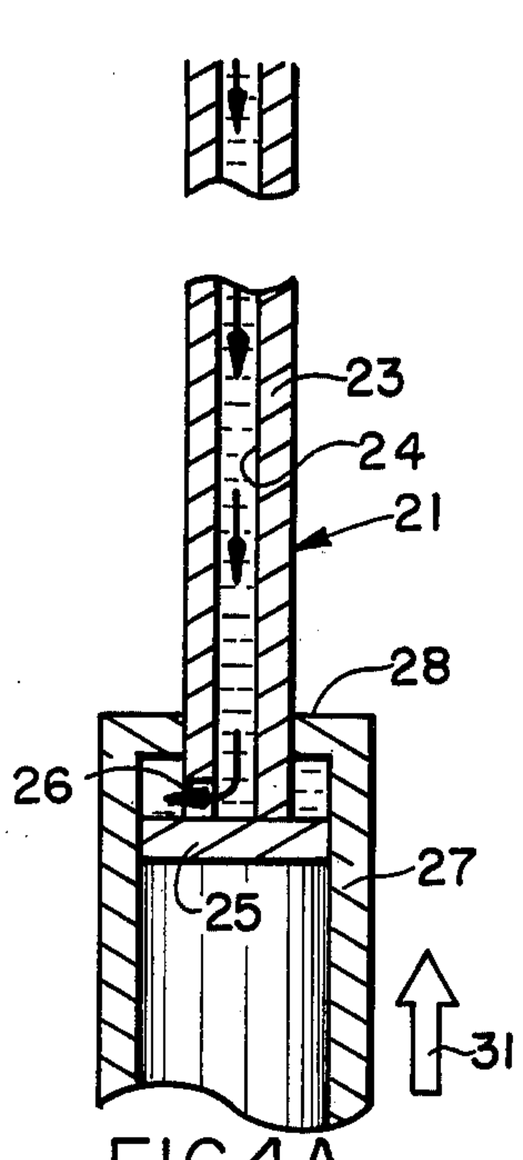


FIG.4A

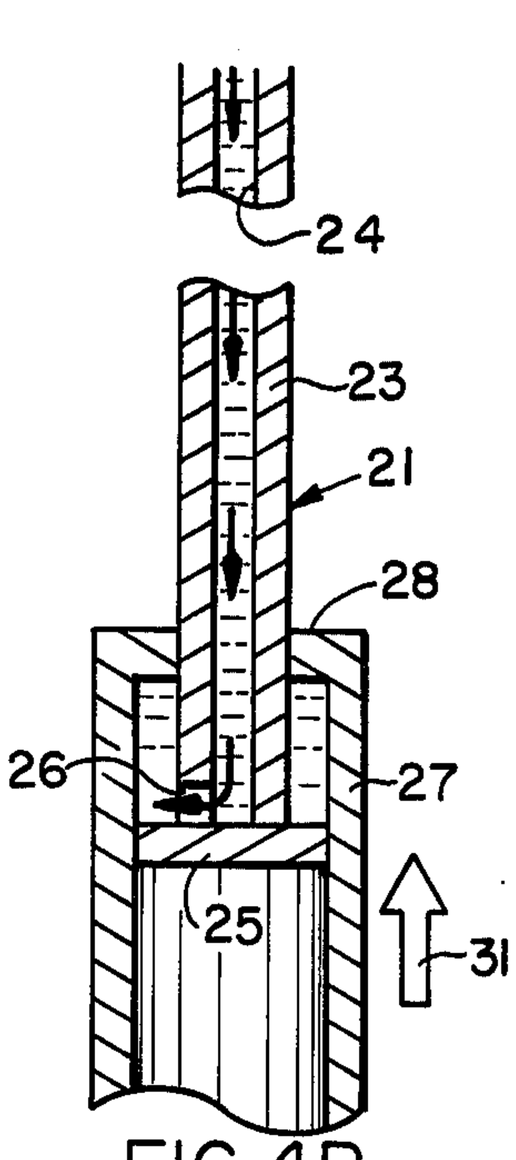


FIG.4B

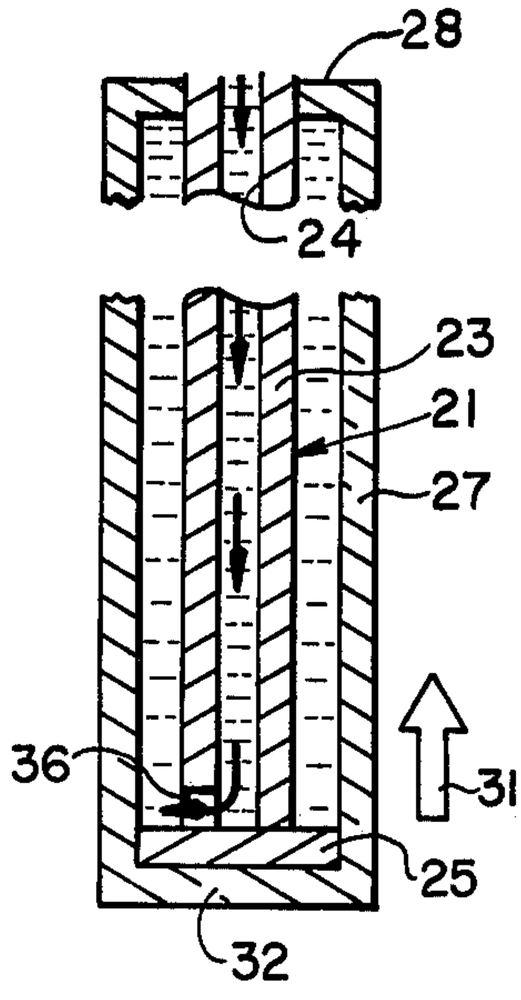


FIG.4C

STABILIZED HYDRAULIC ELEVATOR

BACKGROUND OF THE INVENTION

The use of a differential piston for elevators is known in the prior art. See, for example, U.S. Pat. No. 454,872 issued June 30, 1891 to Otto Krell. A differential piston comprises a hollow piston at the upper portion of the assembly, the hollow piston being of lesser diameter than the cylinder which defines the lower portion of the assembly. The upper end of the hollow piston is attached to a superstructure above the elevator and the lower end of the hollow piston has an annular bore extending between the hollow interior of the piston and the interior of a cylinder which defines the lower portion of the differential piston. A sealing flange is fixed on the lower end of the piston beneath the annular port and frictionally engages the inner surface of the cylinder. Hydraulic fluid introduced into the top of the hollow piston flows through the annular port above the sealing flange and into the cylinder within which the sealing flange of the piston is received. The hollow piston remains stationary at all times and the cylinder reciprocates relative thereto. As hydraulic fluid is introduced into the hollow piston and enters the cylinder through the annular port, the pressure of the build-up of fluid between the inner surface of the top wall of the cylinder and the sealing flange on the piston causes the cylinder to move upwardly relative to the sealing flange thereby shortening the overall length of the assembly. The cab of an elevator is attached to the lower end of the cylinder so that the elevator rises upon the introduction of hydraulic fluid into the hollow piston to shorten the overall length of the differential piston.

The opening of a valve to remove hydraulic fluid from the cylinder causes the cylinder to move downwardly relative to the piston, thereby lengthening the differential piston and causing the elevator to descend.

One obvious advantage of such an arrangement is that it is not necessary to dig a hole in the ground to receive the cylinder of a hydraulic ram and cylinder.

U.S. Pat. No. 3,650,356 issued Mar. 21, 1972 to Richard L. Brown discloses the use of differential pistons to actuate elevators. Brown uses two laterally spaced differential pistons for raising and lowering the elevator cab, whereas Krell uses only a single differential piston for the elevator. The use of two differential pistons is preferable because it gives greater stability to the cab than does a single differential piston. However, according to Brown each of the differential pistons passes through the interior of the cab and through the same transverse plane of the cab, thereby taking away from the usable area of the cab and contributing to the instability of the cab.

Difficulty has also been experienced in the operation of the Brown elevator because of the inaccurate and unreliable registry of the cab with the floor levels.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a hydraulic elevator having a pair of differential pistons suspended along opposite sides of an elevator shaft, one piston on each side of the transverse axis of the cab. A cross beam is attached to the bottom of an elevator cab and extends across the transverse axis between the cylinder components of the differential pistons.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a vertical sectional view of an elevator shaft extending between two floors and showing the elevator in solid lines at the lower floor and in dotted lines at the upper floor;

FIG. **2** is an inverted perspective plan view taken substantially along the line **2—2** in FIG. **1**;

FIG. **2A** is an enlarged fragmentary horizontal sectional view, with parts broken away, illustrating the relationship of the cab, the chair brackets, and the differential pistons;

FIG. **3** is an inverted perspective plan view taken substantially along the line **3—3** in FIG. **1**; and

FIGS. **4A**, **4B** and **4C** are sequential views illustrating the operation of a differential piston.

DETAILED DESCRIPTION OF THE INVENTION

Referring more specifically to the drawings, the numeral **10** broadly designates an existing two story building or structure having, for example, a concrete slab **11** poured directly on the ground G. It will be understood that the illustrated construction of the building **10** is not essential to the invention and there may be an air space between the ground and the first floor **11**, if desired. The building **10** includes an elevator shaft **12** having opposed walls **14**, **15** extending upwardly from the base slab **11** through the ceiling or top wall **13** of a second floor **16** of the two story structure **10**.

An elevator cab **20** is positioned within the shaft **12** for reciprocable movement between the first floor **11** and the second floor **16**. The cab **20** is supported within shaft **12** by differential pistons broadly indicated at **21** and **22**. As used herein the term differential piston refers to that class of ram and cylinder arrangements wherein both the ram and cylinder are hollow for the reception of hydraulic fluid and wherein the introduction of hydraulic fluid into the ram causes the overall length of the ram and cylinder to shorten and consequently to cause the elevator to rise, as most clearly seen in FIGS. **4A**, **4B** and **4C**.

The hollow ram **23** of differential piston **21** has an axially extending passageway **24** through which hydraulic fluid flows in the direction of the directional arrows in FIGS. **4A**, **4B** and **4C** to shorten the differential piston **21** and raise the elevator. The hollow ram **23** also includes a base plate or plunger **25** closing the passageway **24** and projecting radially beyond the axial walls of hollow ram **23**. One wall of hollow ram **23** has a radially extending outlet port **26** adjacent its juncture with base plate or plunger **25**. Plunger **25** is mounted within cylinder **27** in sealing engagement with the inner surfaces of the walls defining cylinder **27**. Hollow ram **23** projects in sealing relation through the top wall **28** of cylinder **27**.

When hydraulic fluid is introduced into hollow ram **23** in the direction of directional arrows in FIGS. **4A**, **4B** and **4C**, the fluid flows through outlet port **26** and accumulates within that portion of the interior of cylinder **27** between plunger **25** and the inner surfaces of the top wall **28** of the cylinder **27**. The upper end of hollow piston **23** is rigidly secured to a superstructure illustrated in the form of an I-beam **30** in FIG. **1**. Hollow ram **23** extends downwardly from superstructure **30** within shaft **12** or to the second floor **16**. Hollow ram **23** is fixed in its postion and does not move.

Referring again to FIGS. 4A, 4B and 4C, as additional hydraulic fluid is introduced into the top of hollow ram **23** and accumulates within the cavity in cylinder **27** between its top wall **28** and plunger **25**, cylinder **27** is moved upwardly in the direction of the arrow **31**. Continued introduction of fluid into the cavity between the top wall **28** and plunger **25** will cause cylinder **27** to rise about hollow ram **23** until plunger **25** engages bottom wall **32** of cylinder **27** as shown in FIG. **4C**.

Differential piston **22** is identical to differential piston **21** and the components of differential piston **21** described in connection with FIGS. **4A**, **4B** and **4C** apply equally to differential piston **22** and the same reference characters are used to identify the components parts of the differential pistons. Although the pistons **21** and **22** are illustrated and described as serving two adjacent floor levels **11** and **16**, it is to be understood that they may be appropriately modified as explained in Brown Patent, 3,650,356 to service all floors of a multi-story structure.

The bottom walls **32** of differential pistons **21** and **22** are secured to a cross beam **33** extending beneath the floor **34** of elevator cab **20**. Cross beam **33** is secured to the lower surface of elevator cab floor **34** as by brackets **35**. The cross beam **33** projects angularly beyond elevator cab **20** to its juncture with bottom walls **32** of respective differential pistons **21** and **22**. Thus, as hydraulic fluid is introduced into hollow ram **23** to shorten the overall length of differential pistons **21** and **22** the elevator cab **20** is raised within elevator shaft **12** from the solid line position on the first floor **11** to the dotted line position of elevator cab **20** on the second floor **16** in FIG. **1**.

A plurality of chair brackets **36** extend in vertically spaced relation to each other along wall **38** of shaft **12**, and each bracket **36** is bolted to its wall of shaft **12** as by bolts **40** extending through out-turned flanges **41** on the ends of the brackets **36**. Each chair bracket **36** on said one wall includes a rear face **42** extending perpendicularly from one flange **41** and a front face **43** extending at an angle from the other flange **41**. A guide face **44** extends between faces **42** and **43** in parallel relation to flanges **41** and spaced inwardly therefrom toward the path of cab **20** as it traverses the shaft **12**.

A plurality of chair brackets **37** extend in vertically spaced relation to each other along wall **39** of shaft **12**. The brackets **37** are like the brackets **36** and are fastened to their wall **39** in the same manner as brackets **36** are fastened to wall **38**. The parts of brackets **37** which are the same as parts of brackets **36** are identified by the same reference characters with the prime notation added. As most clearly seen in FIGS. **2** and **3** the faces **42'** of brackets **37** which extend perpendicularly from the proximal flanges **41'** is on the front side of brackets **37**, whereas corresponding faces **42** on brackets **36** is on the rear side of brackets **36**.

The faces **42** and **42'** and their respective proximal flanges **41**, **41'** define angular pockets **47**, **47'** within which differential pistons **21** and **22**, respectively, are positioned exteriorly of cab **20** and outwardly from respective guide faces **44**, **44'**. The guide faces **44**, **44'** extend vertically in a common plane with the transverse axis A of cab **20** (FIG. **2A**).

Tee rails **45** are fastened to the inner surfaces of guide faces **44**, **44'** and project therefrom toward guide shoes **46** extending vertically along the transverse axis A of cab **20**. The Tee rails **45** engage the guide shoes **46** and stabilize the cab **20** during its vertical movement.

The differential pistons **21** and **22** extend vertically within their pockets **47**, **47'** on opposite sides of the transverse axis A of cab **20**, thereby stabilizing cab **20** and permitting cab **20** to occupy all of the space between opposed Tee rails **45**. This is advantageous in that the stabilized cab is enabled to have the maximum dimensions consistent with the size of the elevator shaft **12**. The cross beam **33** extends at an angle across the transverse axis A and across the lower surface of floor **34** between the off-set differential pistons **21** and **22**, and the I-beam **30** extends at a corresponding angle above the shaft **12** to engage pistons **21** and **22** extending upwardly from their junctures with cross beam **33**. Hollow rams **23** are rigidly connected with opposite end portions of superstructure or I-beam **30**. The open upper ends of hollow rams **23** on differential pistons **21** and **22** communicate with hydraulic lines **50** extending from manifold **51** atop superstructure **30**. Hydraulic fluid is pumped through hydraulic lines **50** into differential pistons **21** and **22** from a suitably located reservoir, not shown.

There is thus provided an improved support system for stabilizing the cab during transit.

In the drawings and specification there has been set forth a preferred embodiment of the invention and although specific terms are employed they are used in a descriptive and generic sense only and not for pusposes of limitation, the scope of the invention being defined in the claims.

We claim:

1. A hydraulic elevator having a cab vertically reciprocable within a shaft between chair brackets spaced vertically along opposed walls of the shaft and a superstructure above the shaft, said cab having a first transverse axis extending in one direction and a second transverse axis extending in perpendicular relation to said first transverse axis and said elevator including only two differential pistons extending in spaced vertical planes between said axes and between the superstructure and the cab, means connecting corresponding ends of the differential pistons to the superstructure and the cab, and means for flowing hydraulic fluid into and out of the differential pistons to move the elevator vertically within the shaft.

2. In a hydraulic elevator having a superstructure, a cab, means on opposite sides of the cab for guiding the cab during vertical movement, and said cab having a transverse axis extending between its said opposite sides, the combination of means supporting the cab from the superstructure for vertically reciprocable movement within the shaft, said means comprising only two hydraulically operable piston and cylinder assemblies each including a fixed piston rigidly secured to the superstructure and a vertically reciprocable cylinder attached at its lower end to the cab, and the piston and cylinder assemblies extending along opposite sides of the transverse axis of the cab.

3. A hydraulic elevator having a cab vertically reciprocable within a shaft between chair brackets spaced vertically along opposed walls of the shaft and a superstructure above the shaft, said cab having a transverse axis extending between the said opposed walls and said elevator including only two differential pistons extending in spaced vertical planes on opposite sides of said transverse axis between the superstructure and the cab, means connecting corresponding ends of the differential pistons to the superstructure and the cab, and means for

flowing hydraulic fluid into and out of the differential pistons to move the elevator vertically within the shaft.

4. A hydraulic elevator according to claim 3 wherein each of said chair brackets includes a guide face and Tee-rails fastened to the inner surfaces of the guide faces and projecting inwardly therefrom, guide shoes projecting outwardly from opposed walls of the cab, and said Tee-rails engaging the guide shoes to stabilize the cab during its vertical movement.

5. A hydraulic elevator according to claim 4 wherein the guide shoes project outwardly along the transverse axis of said cab.

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